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LakeMIP-Kivu
&
the impact of the African Great Lakes on the regional climate

W. Thiery[1], V. Stepanenko[2], X. Fang[3], K. Jöhnk[4], Z. Li[5], A. Martynov[6], M. Perroud[7], Z. Subin[8], F. Darchambeau[9], D. Mironov[10], N. van Lipzig[1]

[1] KU Leuven, Belgium
[2] MSU, Russia
[3] AU, Alabama
[4] CSIRO, Australia
[5] TU, China
[6] UQAM, Canada
[7] SFOE, Switzerland
[8] Princeton, New jersey
[9] Ulg, Belgium
[10] DWD, Germany

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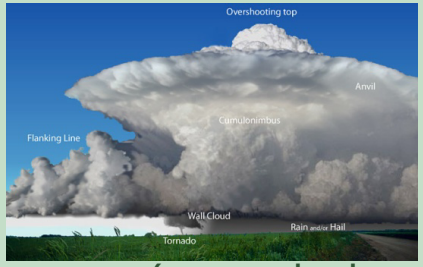
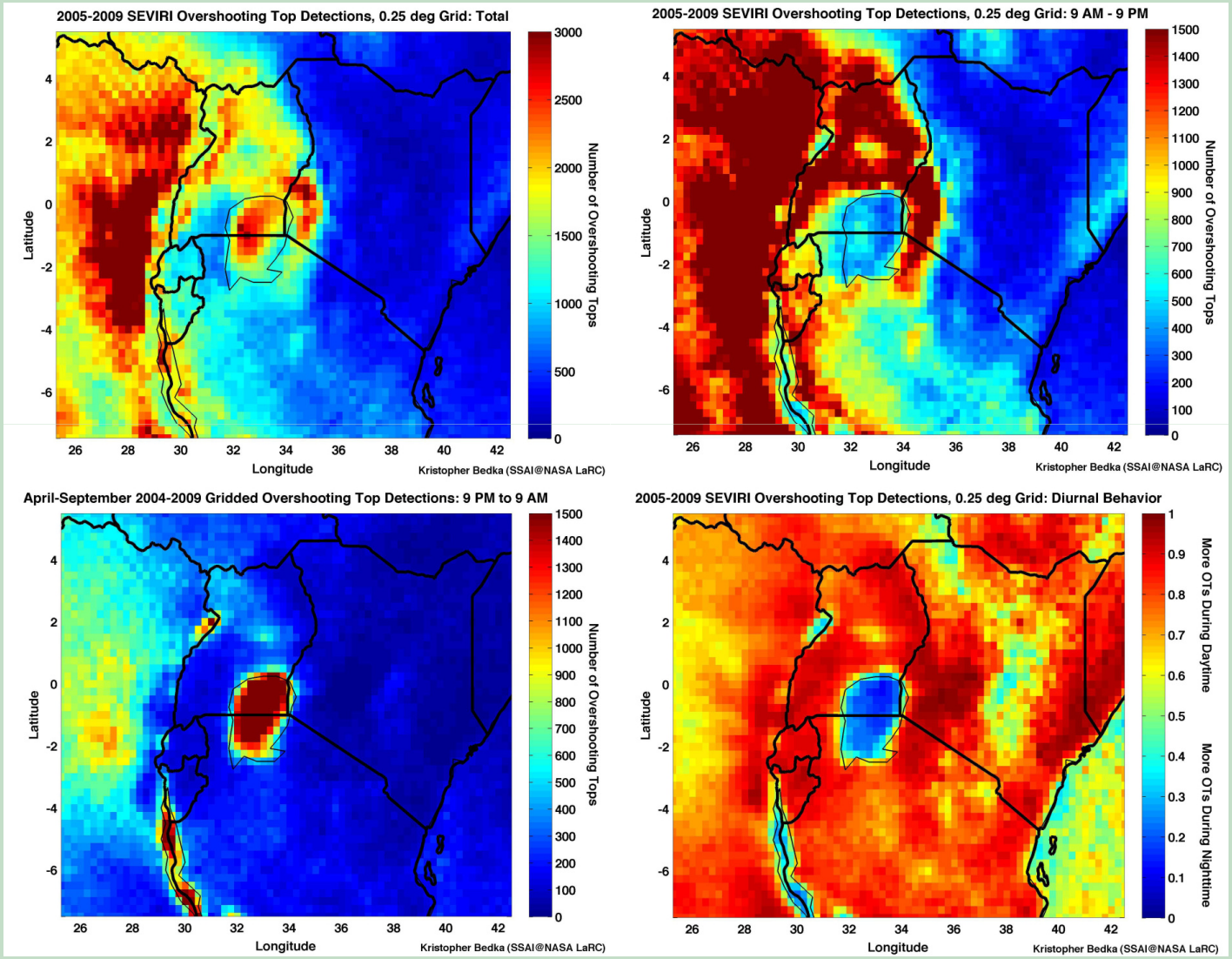
Motivation and objectives



(severe-wx.pbworks.com)



(Bedka, pers. comm.)

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Motivation and objectives

(Lake Kivu)

reproduce T_{lake}? **in RCM?** **impact?**

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LakeMIP Kivu

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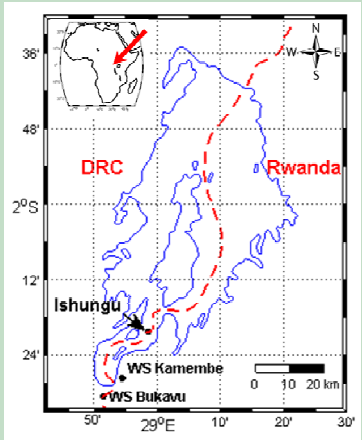
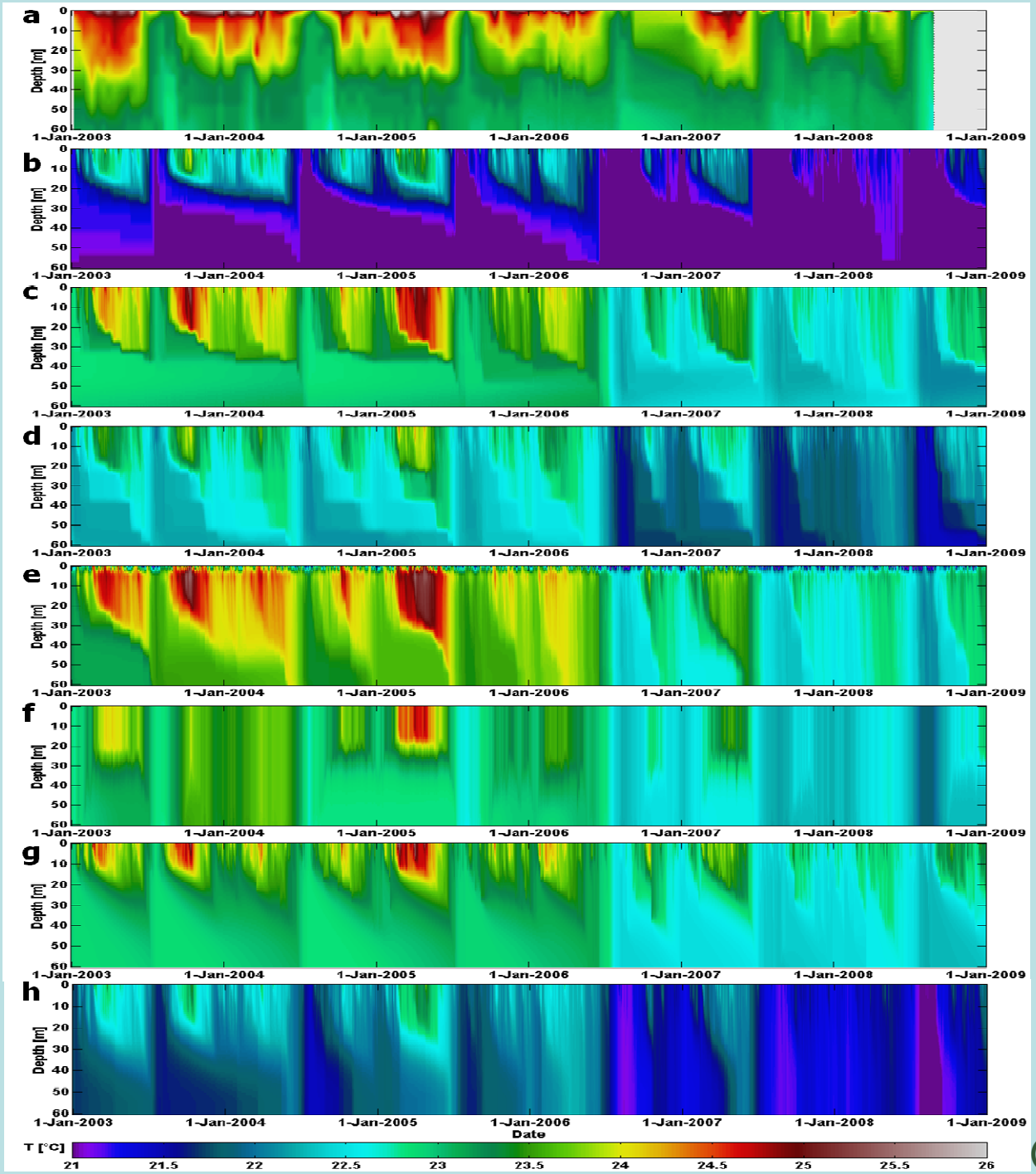
Method: AWSs drive offline models

- 7 one-dimensional lake models:
  Hostetler, LAKEoneD, SimStrat, LAKE, FLake, MINLAKE12 & CLM4-LISSS
- Unified protocol:
  - two main simulations: 60m freshwater & 240m salinity
  - two forcing AWSs: Bukavu & Kamembe





observations

Hostetler

LAKEoneD

SimStrat

LAKE

Although T_{bot} is extremely sensitive to extpar and forcing, T_{surf} predictions are robust (Thiery et al., GMD in rev.)

FLake

MINLAKE2012

CLM4-LISSS

(Thiery et al., TA in rev.)

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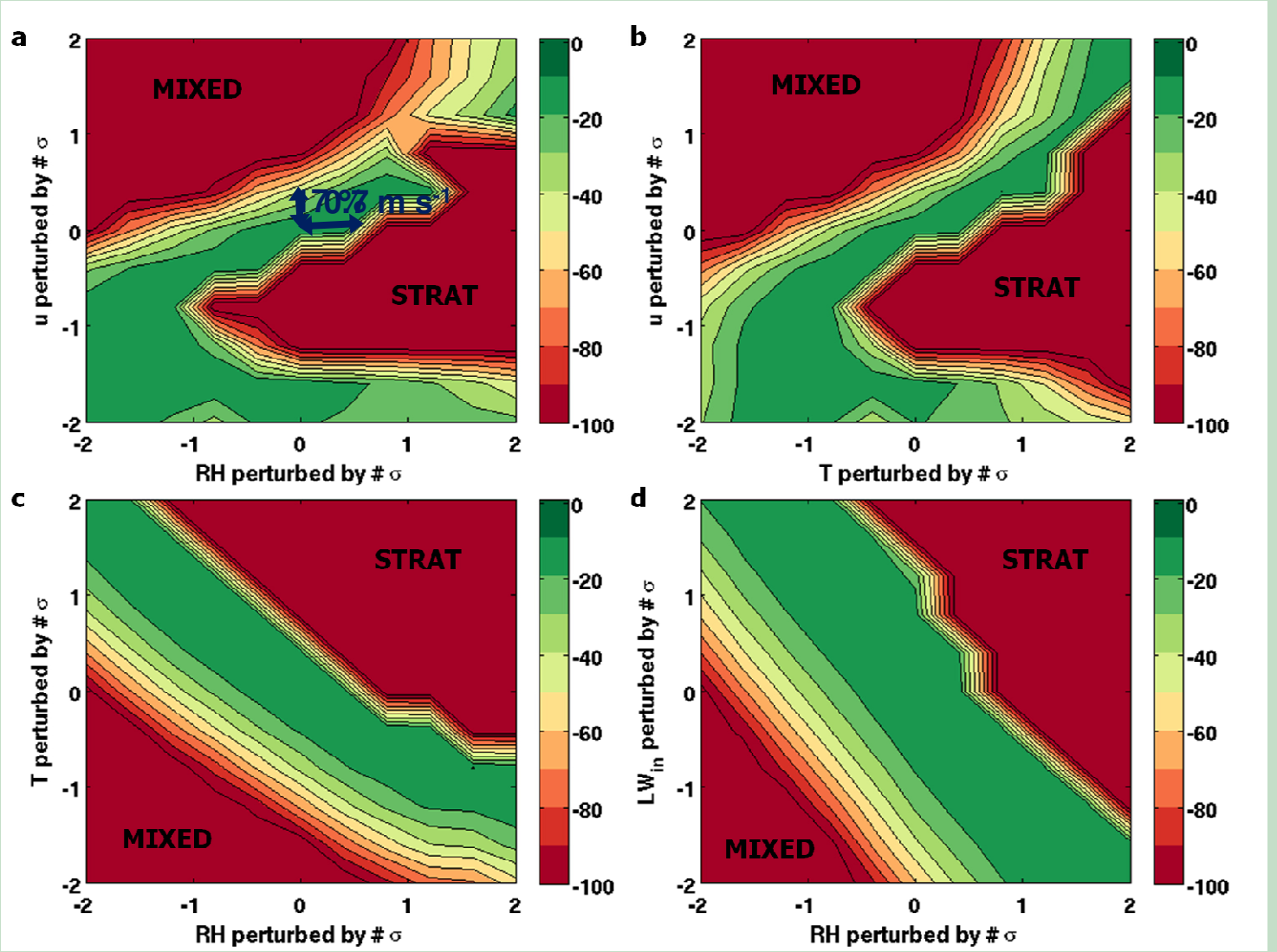
FLake Sensitivity to forcing fields



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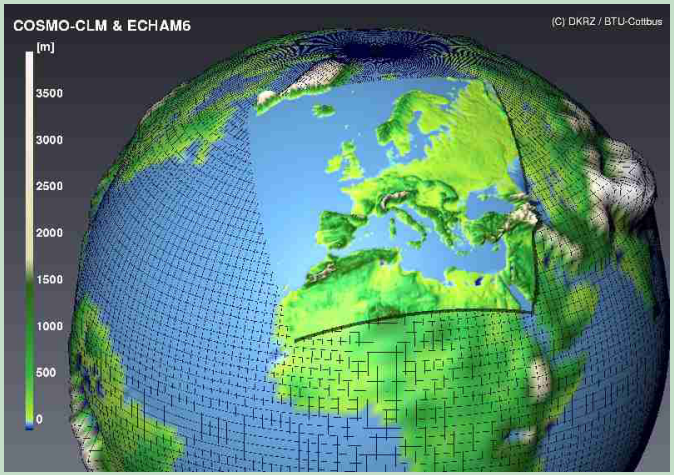
RCM evaluation



(http://www.clm-community.eu/)

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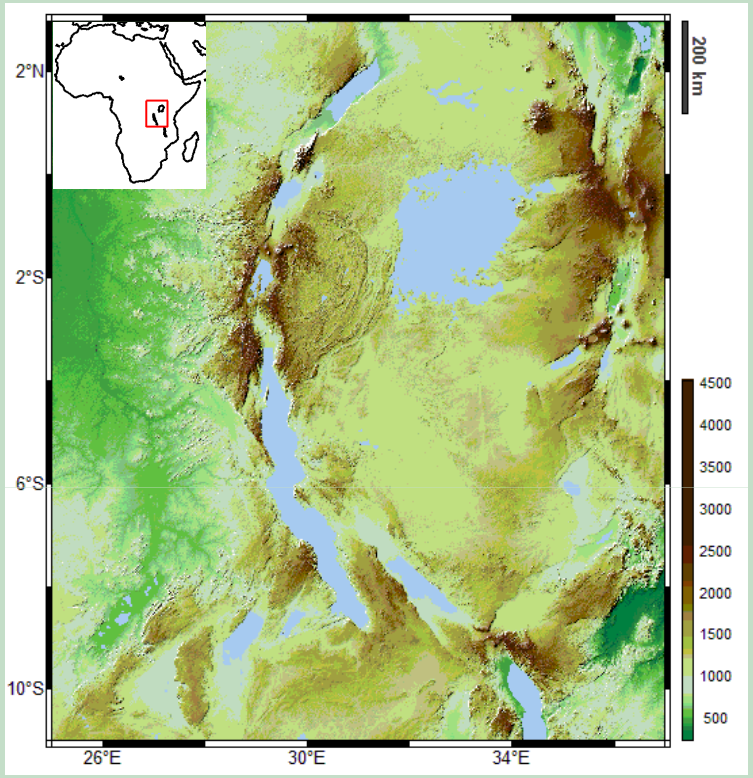
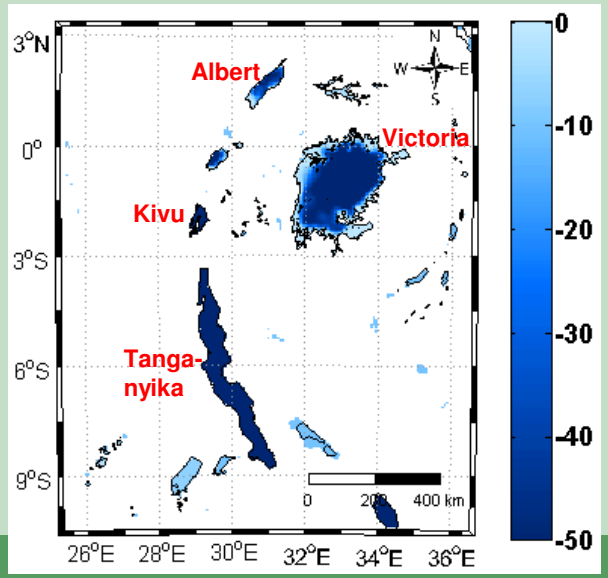
Model setup

- **AGLs**
- **0.062°, 180 x 220 grid points**
- **Three configurations:**
  - **CCLM SST**
  - **CCLM FLake**
  - **CCLM²** **(Davin & Seneviratne, BG 2012)**
- **LBC by CORDEX Africa evaluation simulation 0.44°** **(Panitz et al., CD 2013)**
- **2002**





Lake bathymetry in FLake [m]

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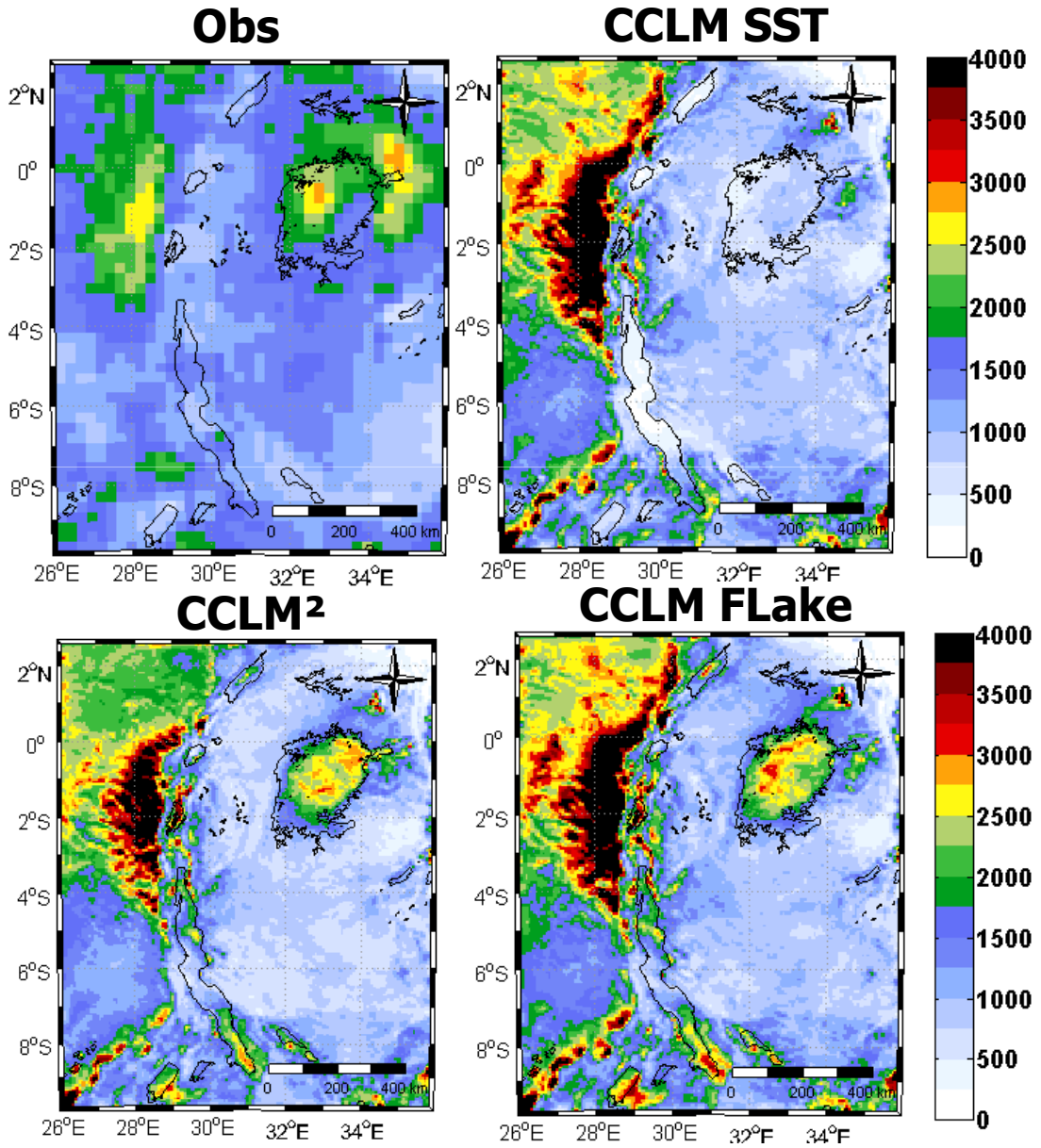
Evaluation: TRMM precipitation



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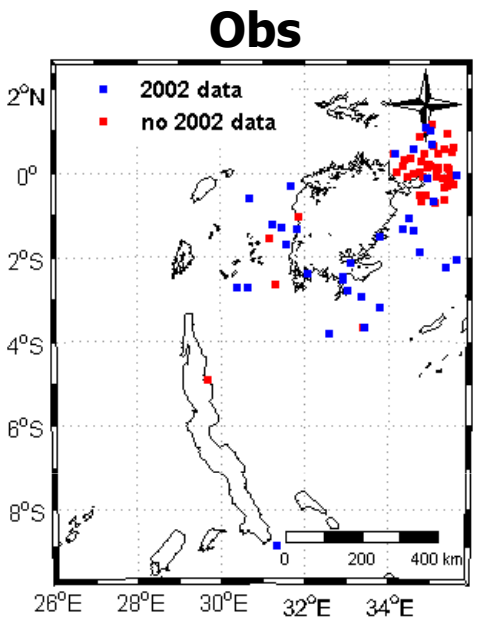
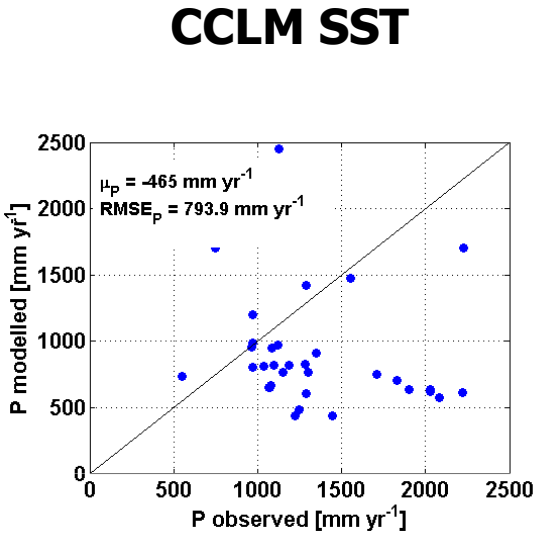
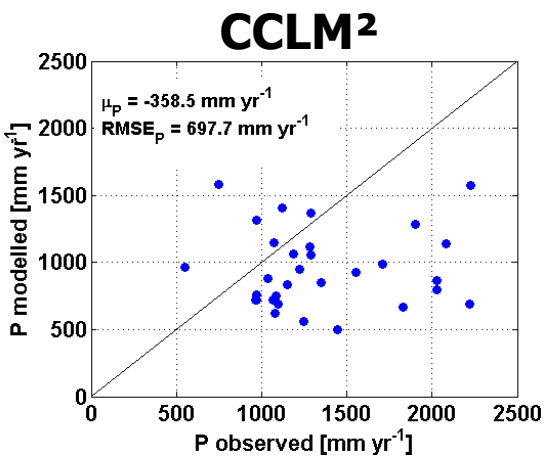
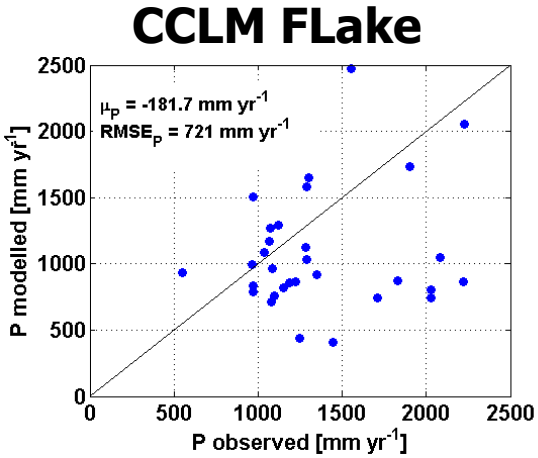
Evaluation: in-situ precipitation

Currently 88 stations within model domain, but only 36 have data for 2002

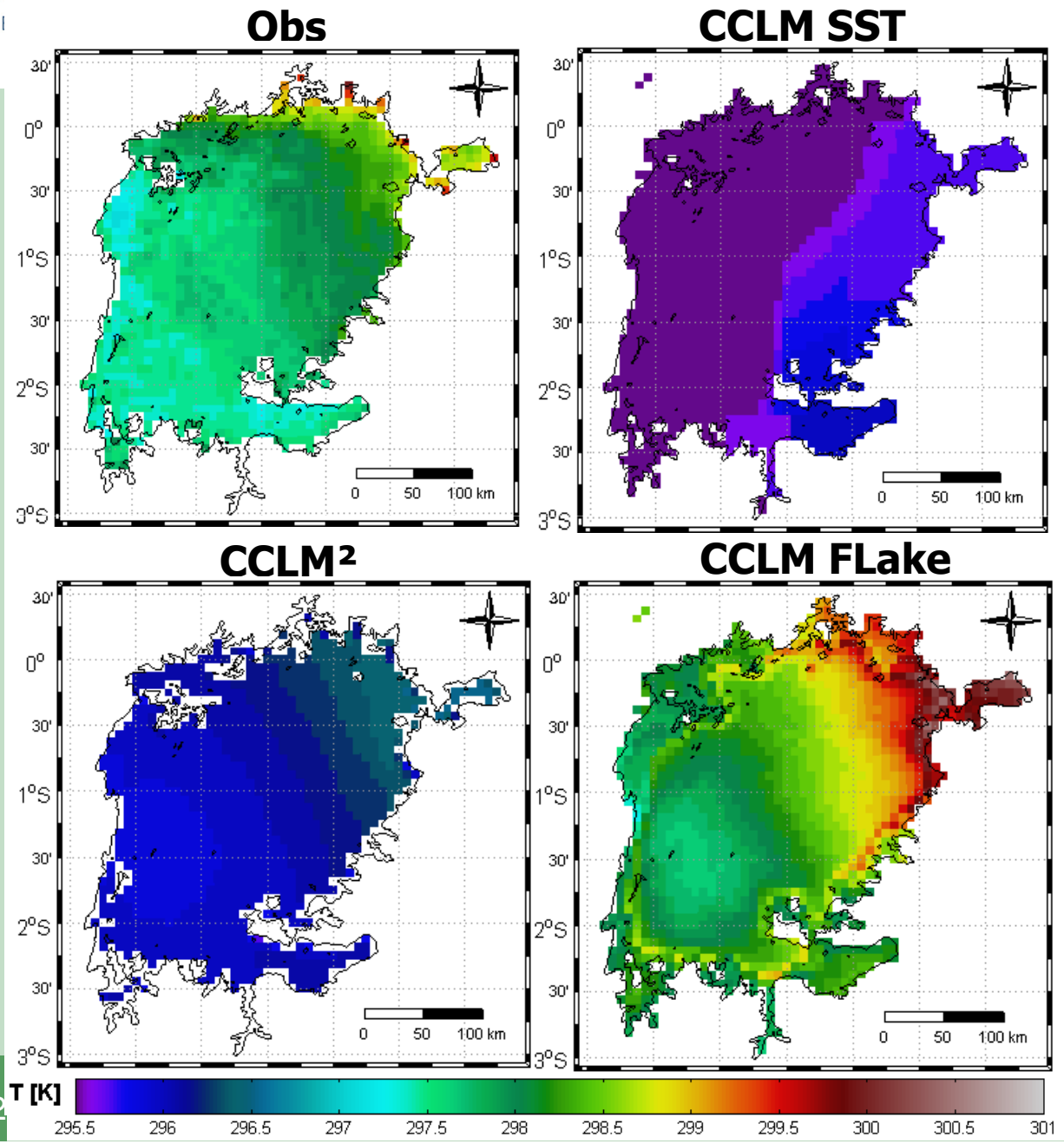


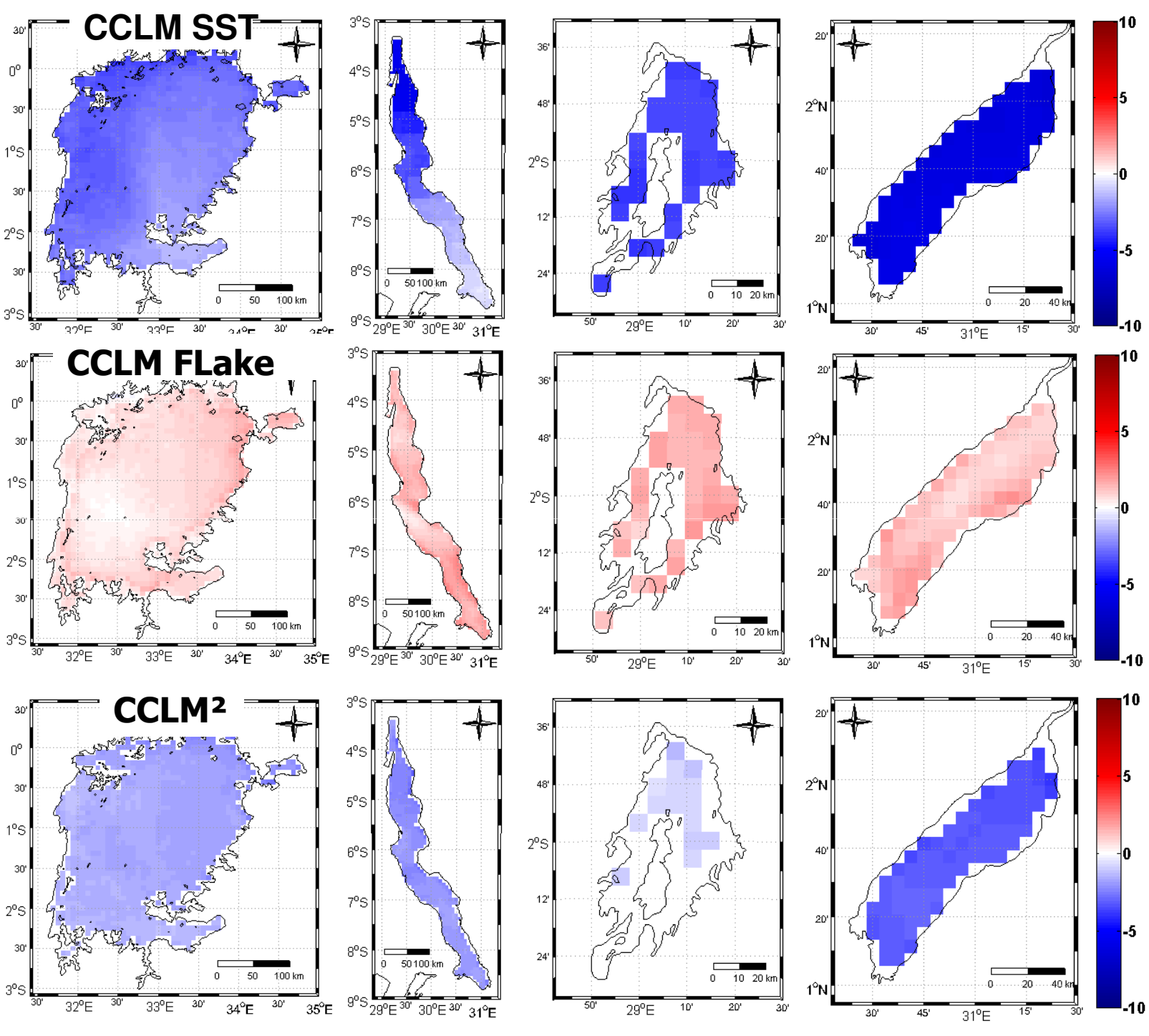






Evaluation: ARC Lake Victoria




CCLM SST
CCLM FLake
CCLM²
Bias [K]
10
5
0
-5
-10

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Impact of AGLs on the regional climate

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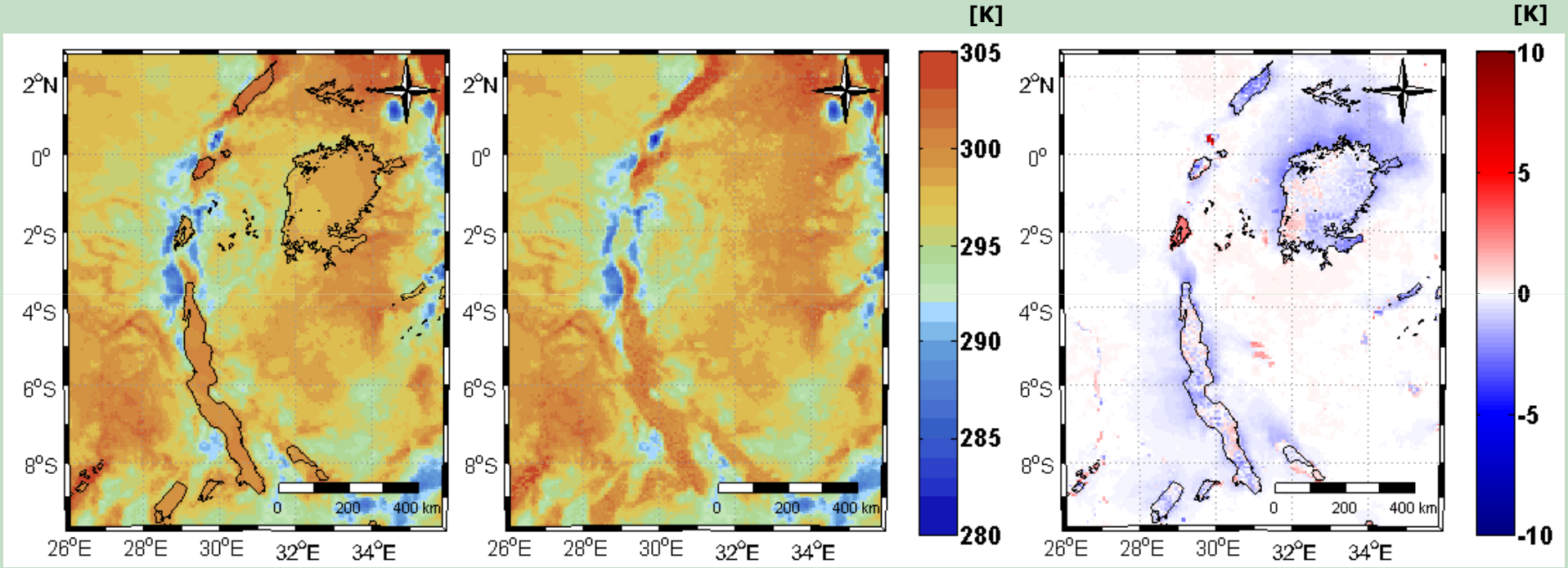
Impact on surface temperature



CCLM FLake **CCLM nolakes** **FLake - nolakes**

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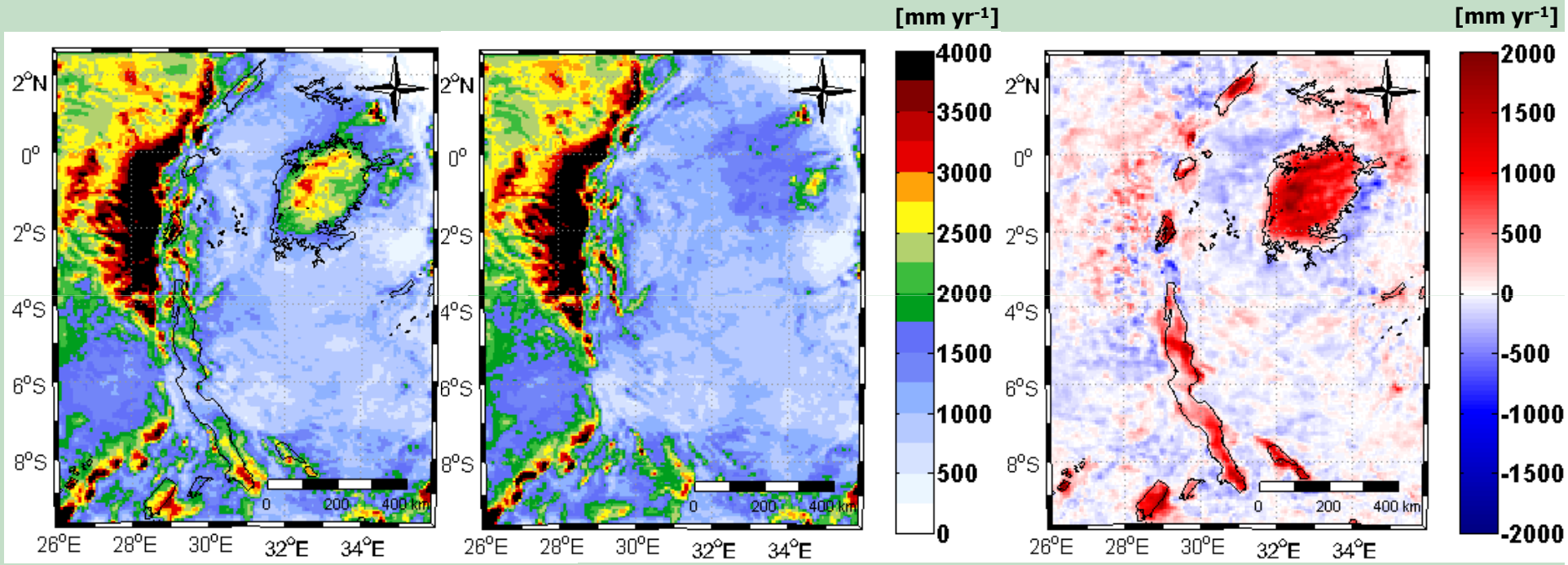
Impact on precipitation



CCLM FLake **CCLM nolakes** **FLake - nolakes**

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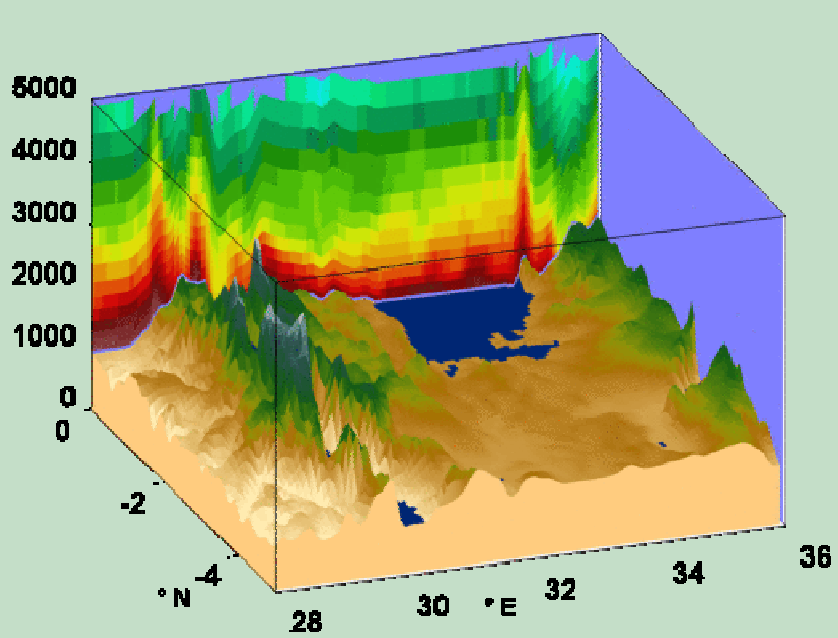
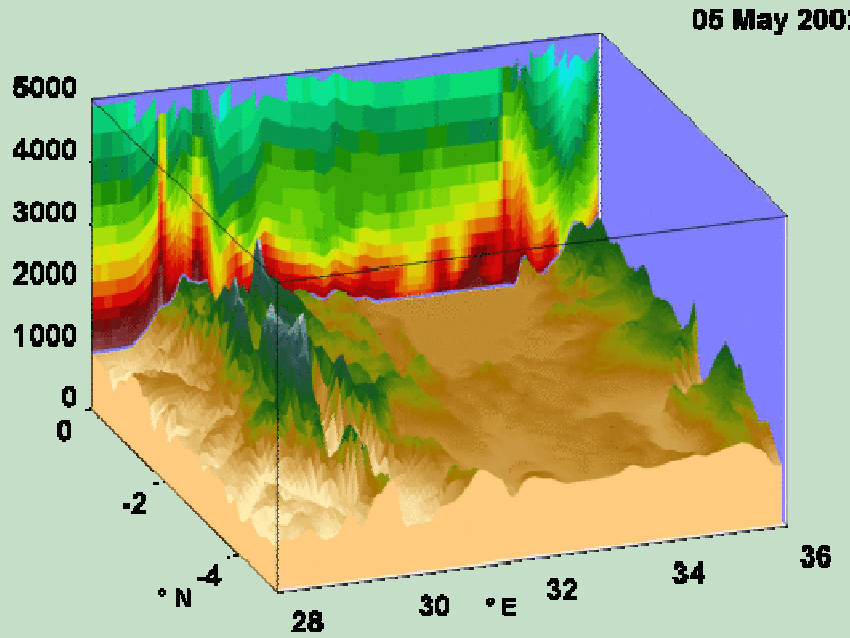
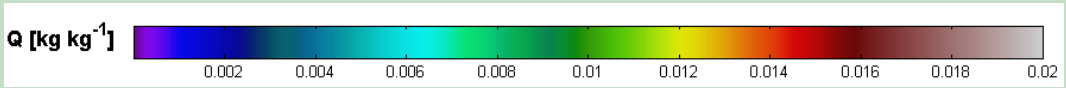
Impact on convective storm development



CCLM FLake



CCLM nolakes




Thank you for your attention!
Acknowledgements: FWO, BELSPO, Edouard Davin
wim.thiery@ees.kuleuven.be

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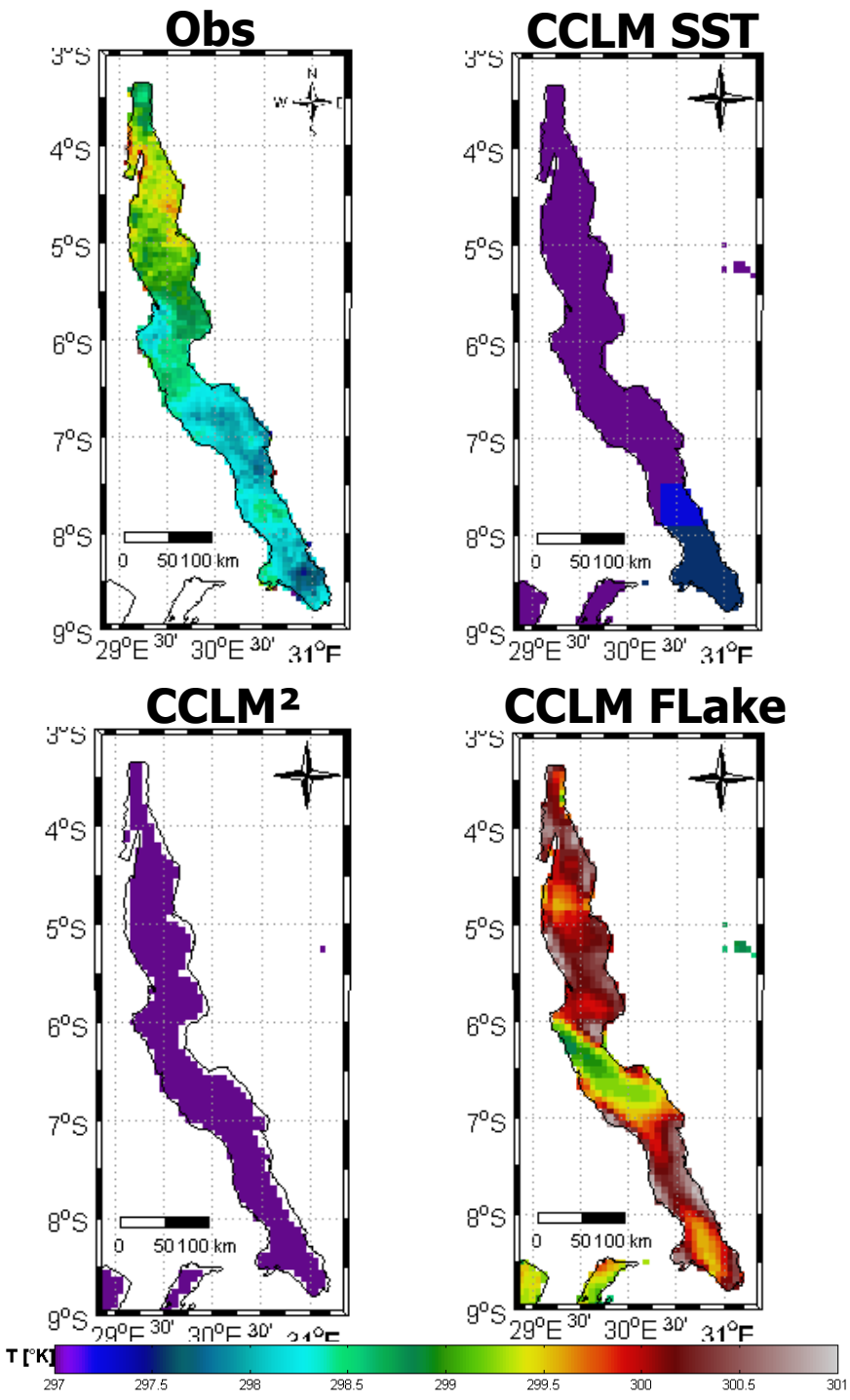
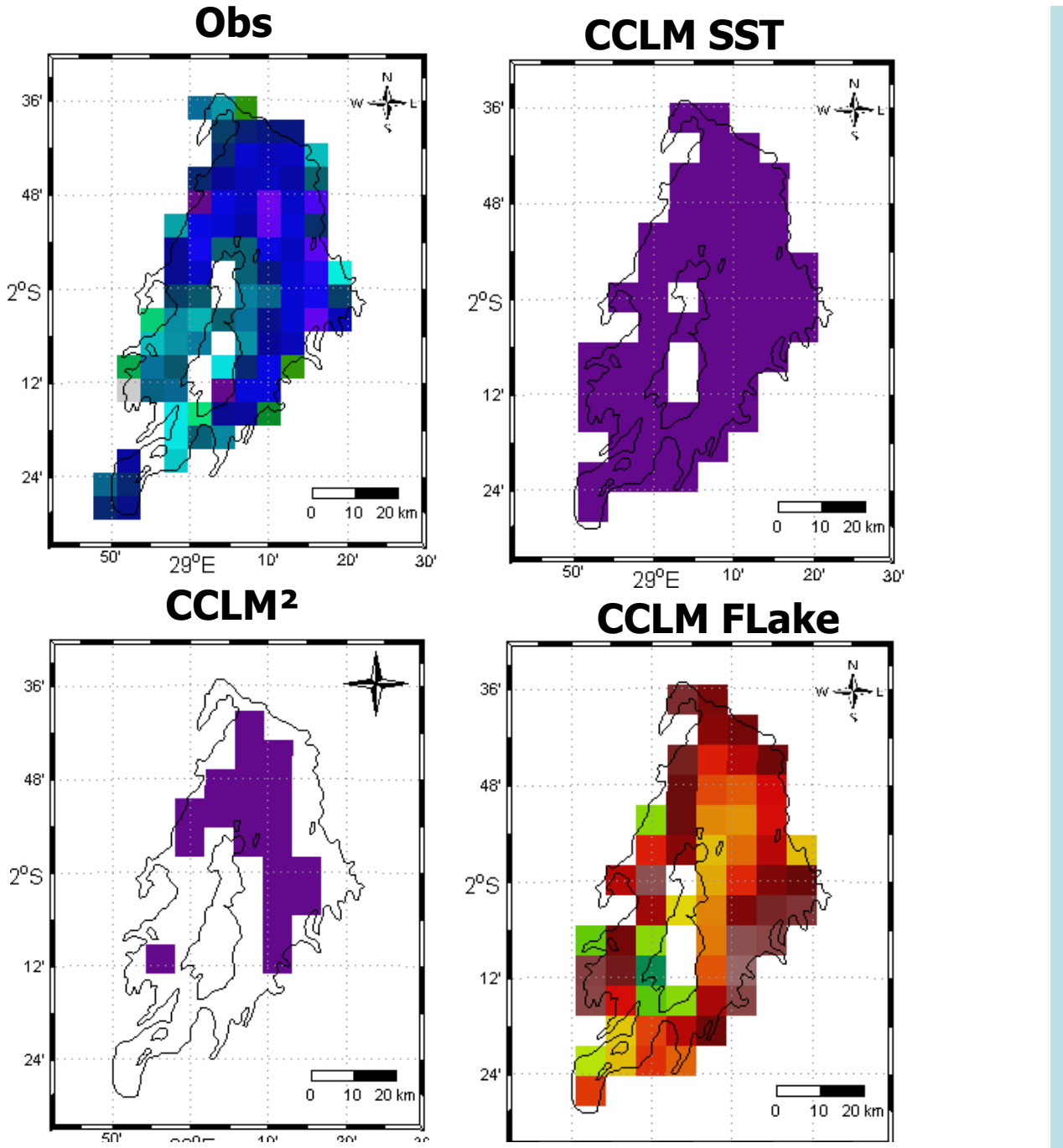
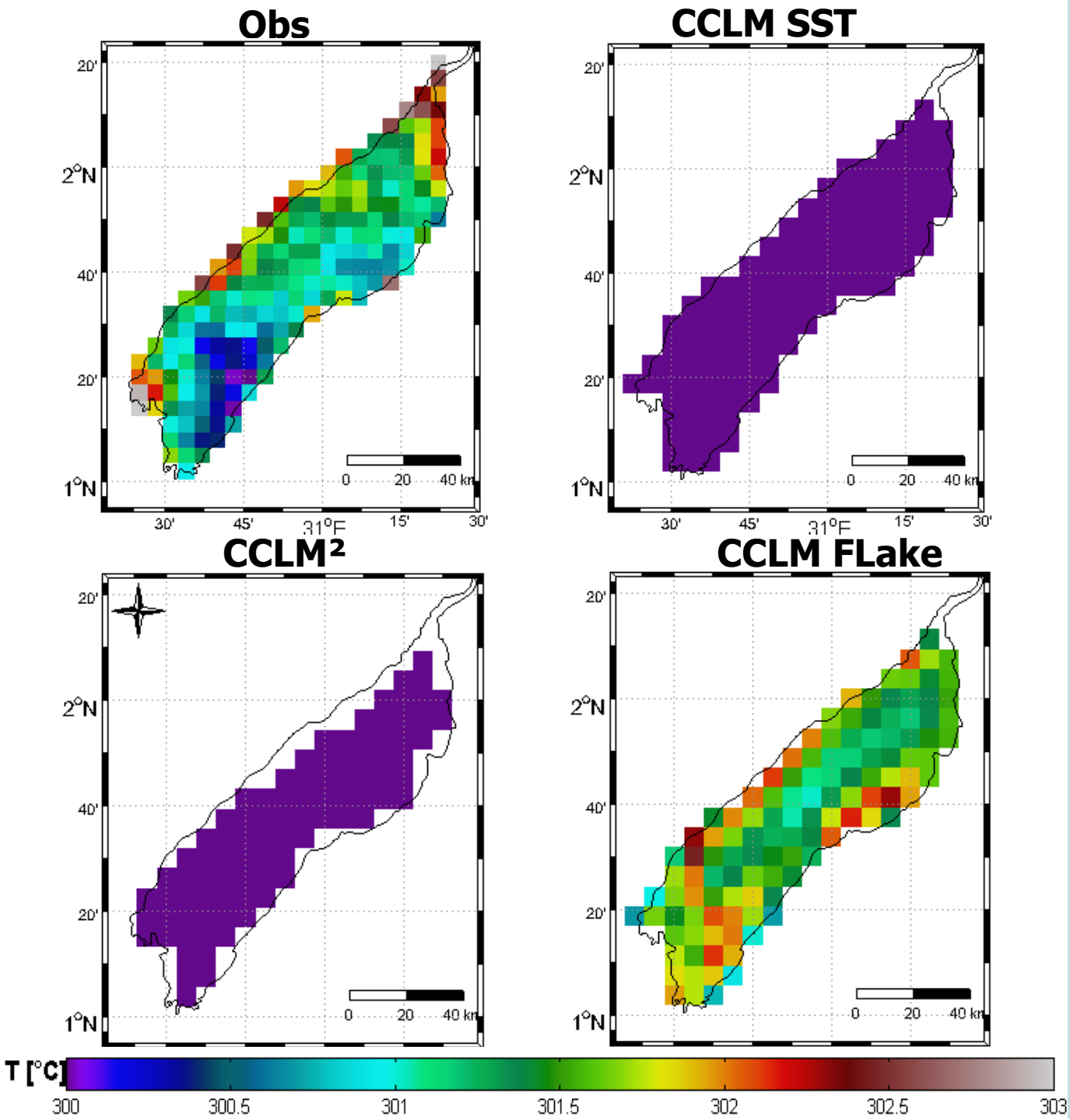
Conclusions & outlook

- conclusions
  - most lake models succeed well in reproducing observed lake temperatures
  - relatively simple models show some deficiencies, but are – for now – the only candidates for operational climate simulations
  - switching on the lake model strongly improves the predictive quality of CCLM
  - for CCLM², a cold bias in the lake temperatures compensates the skill of the LSM
  - AGLs have a significant impact on the regional climate by:
    - cooling the surface layer
    - strongly enhancing precipitation amounts
    - triggering nighttime deep convection

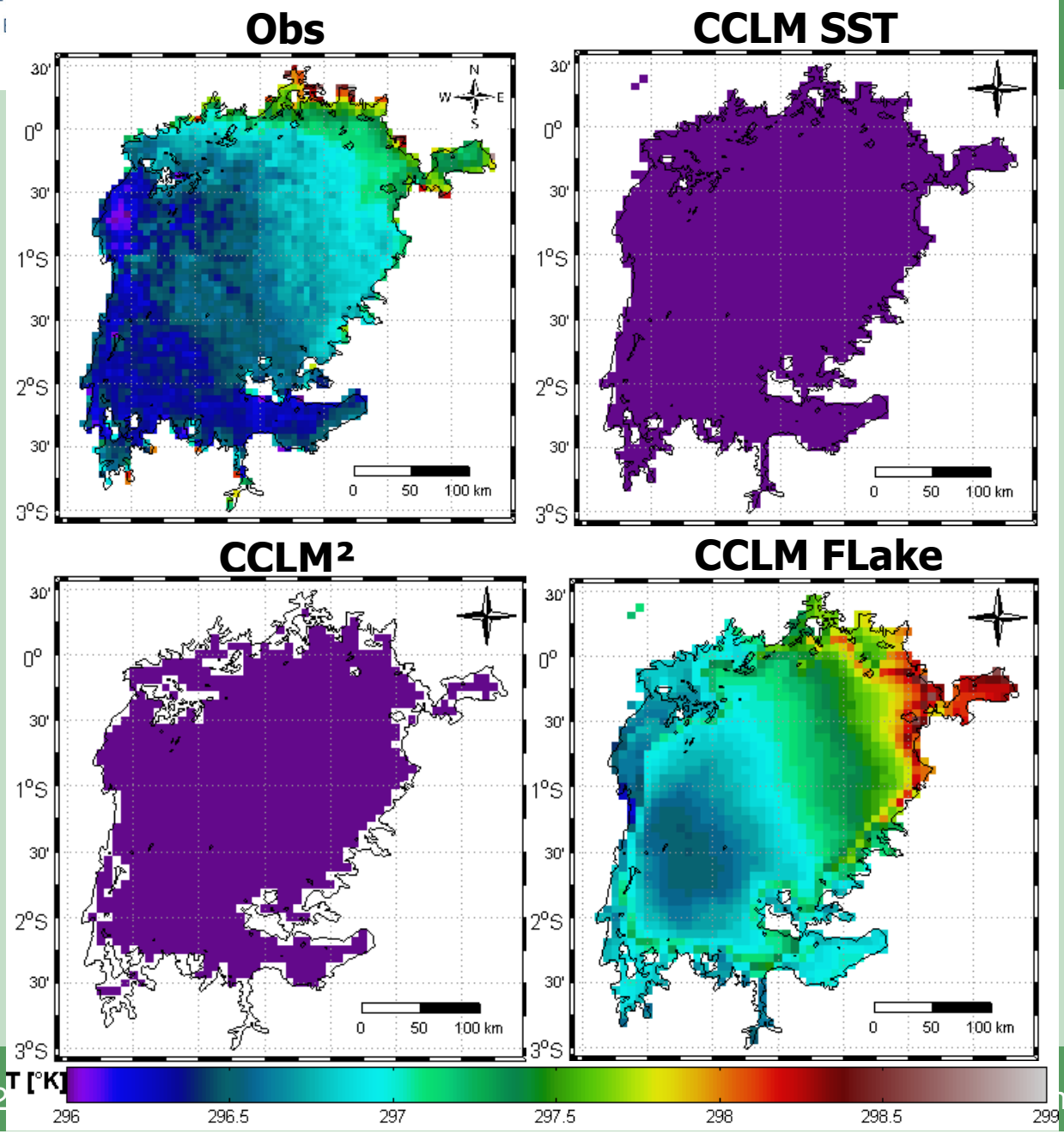
- outlook
  - improve/update lake models?
  - extend simulations to 10 years
  - extend evaluation to more variables
  - analyse impact on circulation


Obs
CCLM SST
CCLM²
CCLM FLake
4°S
5°S
6°S
7°S
8°S
9°S
29°E
30°E
31°E
0 50 100 km
T [°K]
297
297.5
298
298.5
299
299.5
300
300.5
301


Obs
CCLM SST
CCLM²
CCLM FLake
36'
48'
2°S
12'
24'
50'
29°E
10'
20'
30'
N
W
L
S
0 10 20 km
T [°C]
296
296.5
297
297.5
298
298.5
299


Obs
CCLM SST
CCLM²
CCLM FLake
20'
2°N
40'
20'
1°N
30'
45'
31°E
15'
30'
0
20
40 km
T [°C]
300
300.5
301
301.5
302
302.5
303

Evaluation: ARC Lake Victoria



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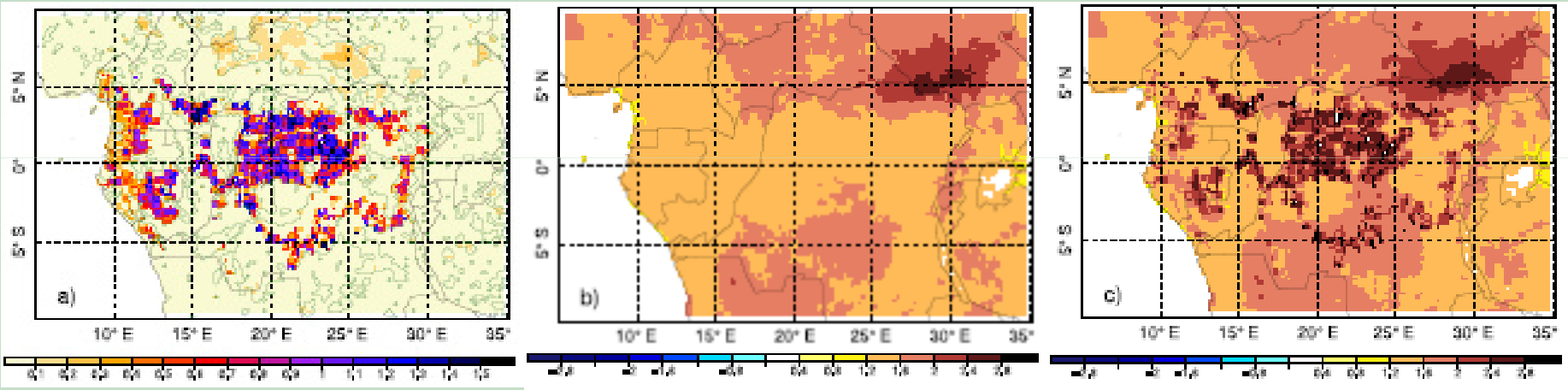
CCLM² over tropical Africa

ECHAM5 → CCLM² (0.22°; A1B): future (2041-2060) – present (1990-2009)



Impact deforestation **Impact GHG** **Total impact**

(Akkermans et al., JC in rev.)

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Why no temperature evaluation (yet)

- CRU: only 1 station within our model domain...
- Krahenman: granted, but only 2008 and 0.22°
- Willems: much less stations than precipitation:
  - Tmax: 2 stations
  - Tmin: 7 stations